FIG. 1

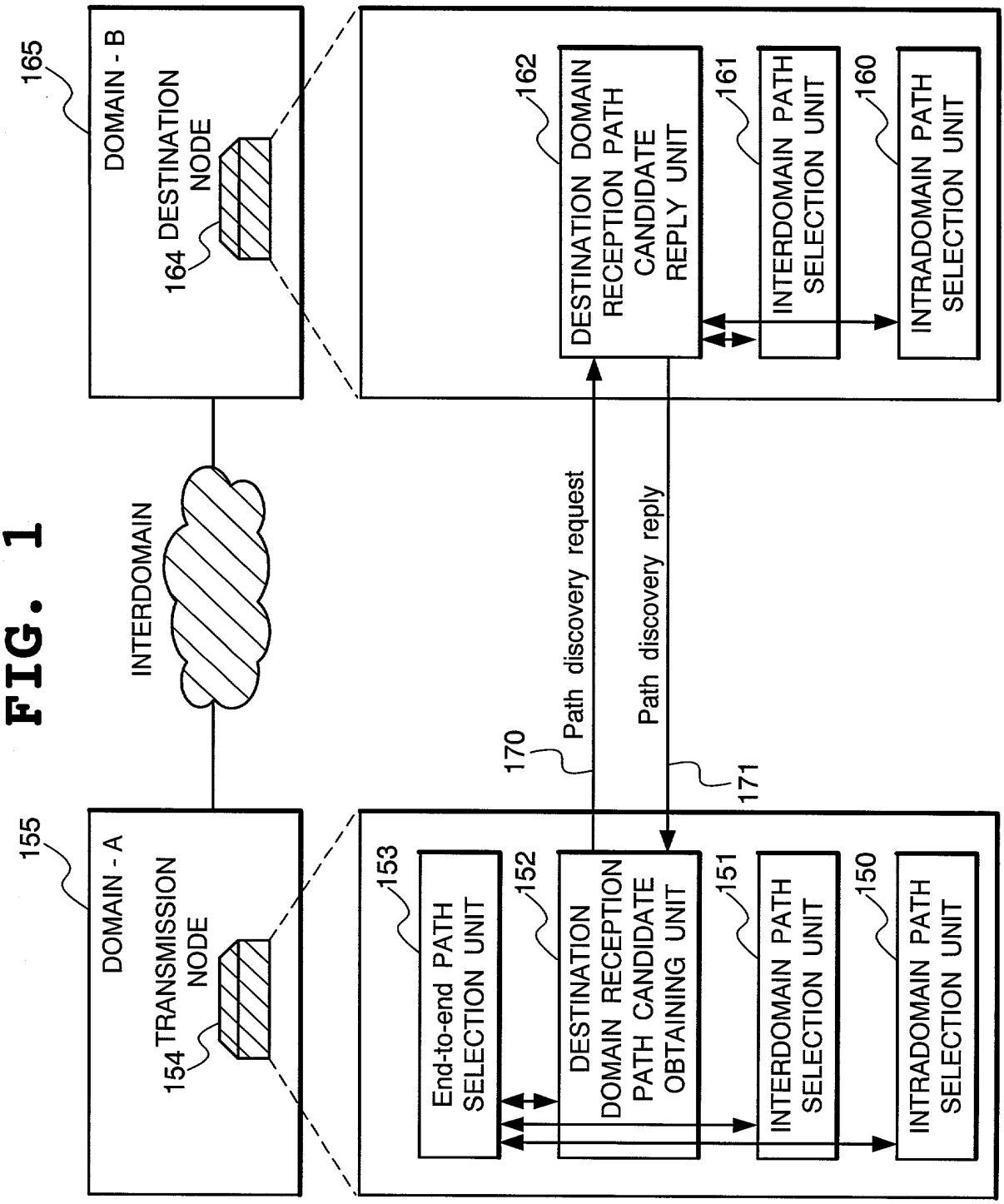

DOMAIN - A
155
TRANSMISSION NODE
154
DOMAIN - B
165
DESTINATION NODE
164
INTERDOMAIN
End-to-end PATH SELECTION UNIT
153
DESTINATION DOMAIN RECEPTION PATH CANDIDATE OBTAINING UNIT
152
INTERDOMAIN PATH SELECTION UNIT
151
INTRADOMAIN PATH SELECTION UNIT
150
DESTINATION DOMAIN RECEPTION PATH CANDIDATE REPLY UNIT
162
INTERDOMAIN PATH SELECTION UNIT
161
INTRADOMAIN PATH SELECTION UNIT
160
170
Path discovery request
171
Path discovery reply

FIG. 2

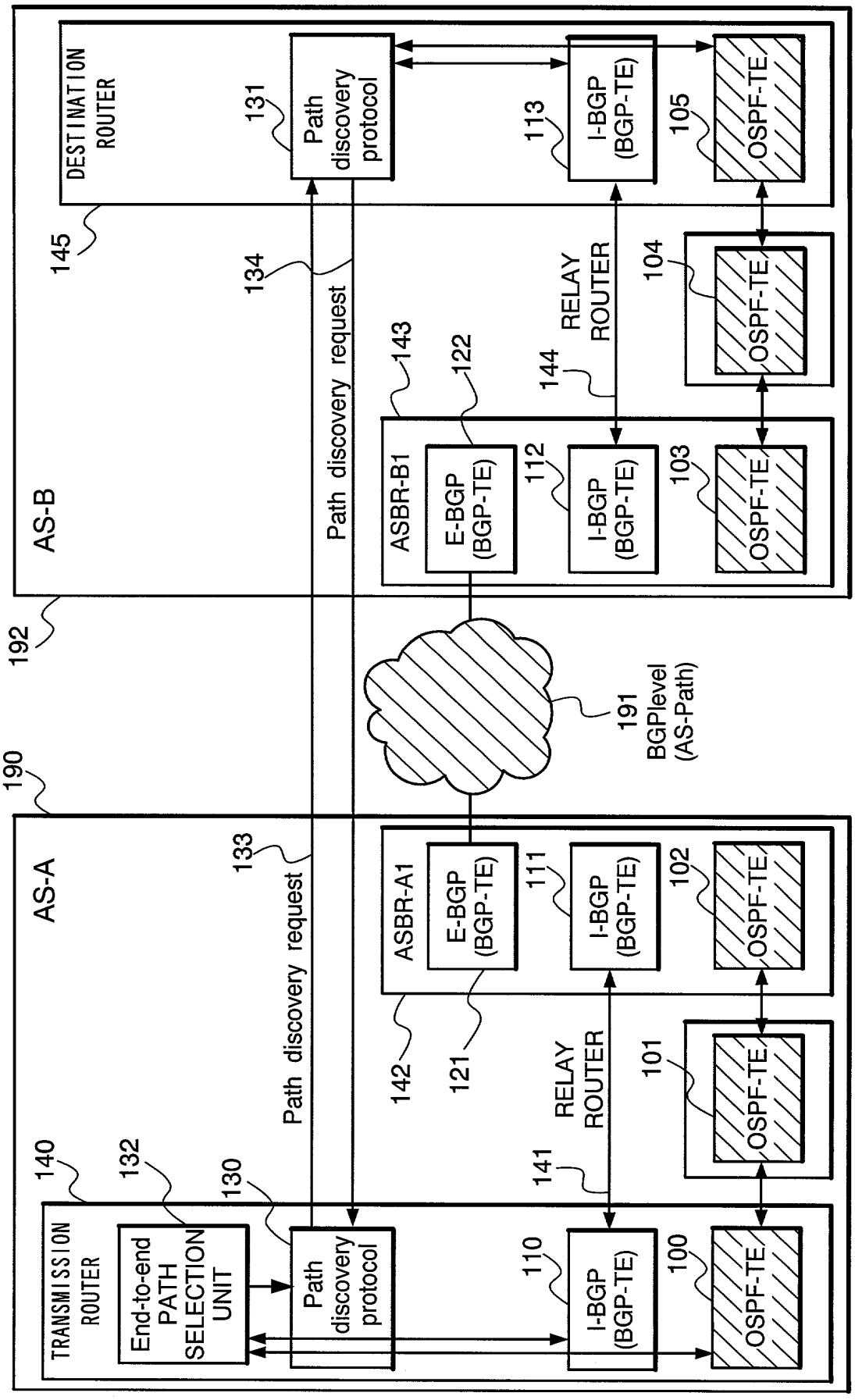

AS-A
AS-B
190
192
191
BGPlevel
(AS-Path)
TRANSMISSION ROUTER
End-to-end PATH SELECTION UNIT
Path discovery protocol
DESTINATION ROUTER
Path discovery protocol
ASBR-A1
ASBR-B1
E-BGP (BGP-TE)
I-BGP (BGP-TE)
OSPF-TE
RELAY ROUTER
Path discovery request
Path discovery request
130
131
132
133
134
140
141
142
143
144
145
100
101
102
103
104
105
110
111
112
113
121
122

FIG. 3

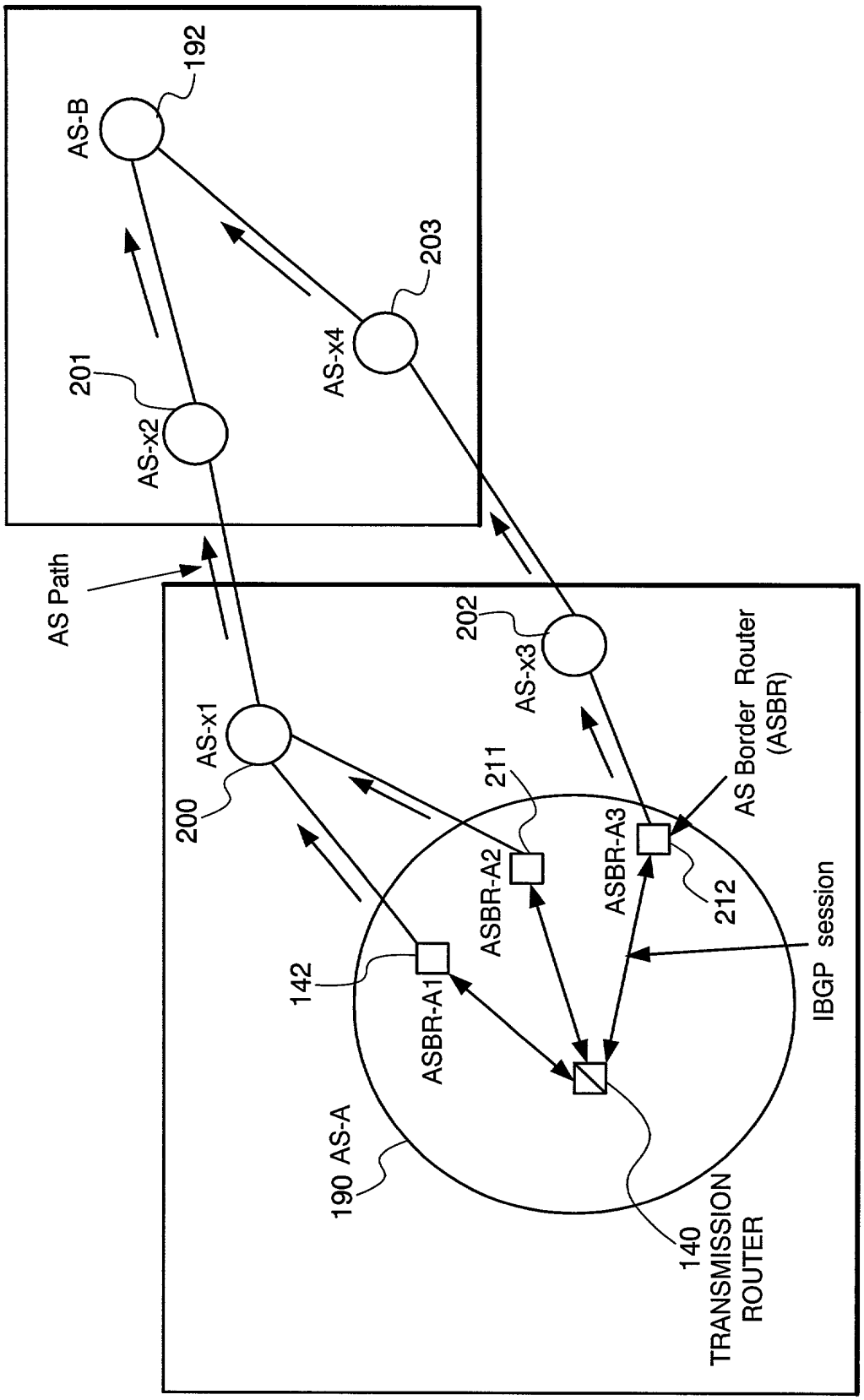

AS-B
192
AS-x4
203
201
AS-x2
AS Path
202
AS-x3
AS-x1
200
211
ASBR-A2
ASBR-A3
AS Border Router
(ASBR)
212
142
ASBR-A1
IBGP session
190 AS-A
140
TRANSMISSION
ROUTER

FIG. 4

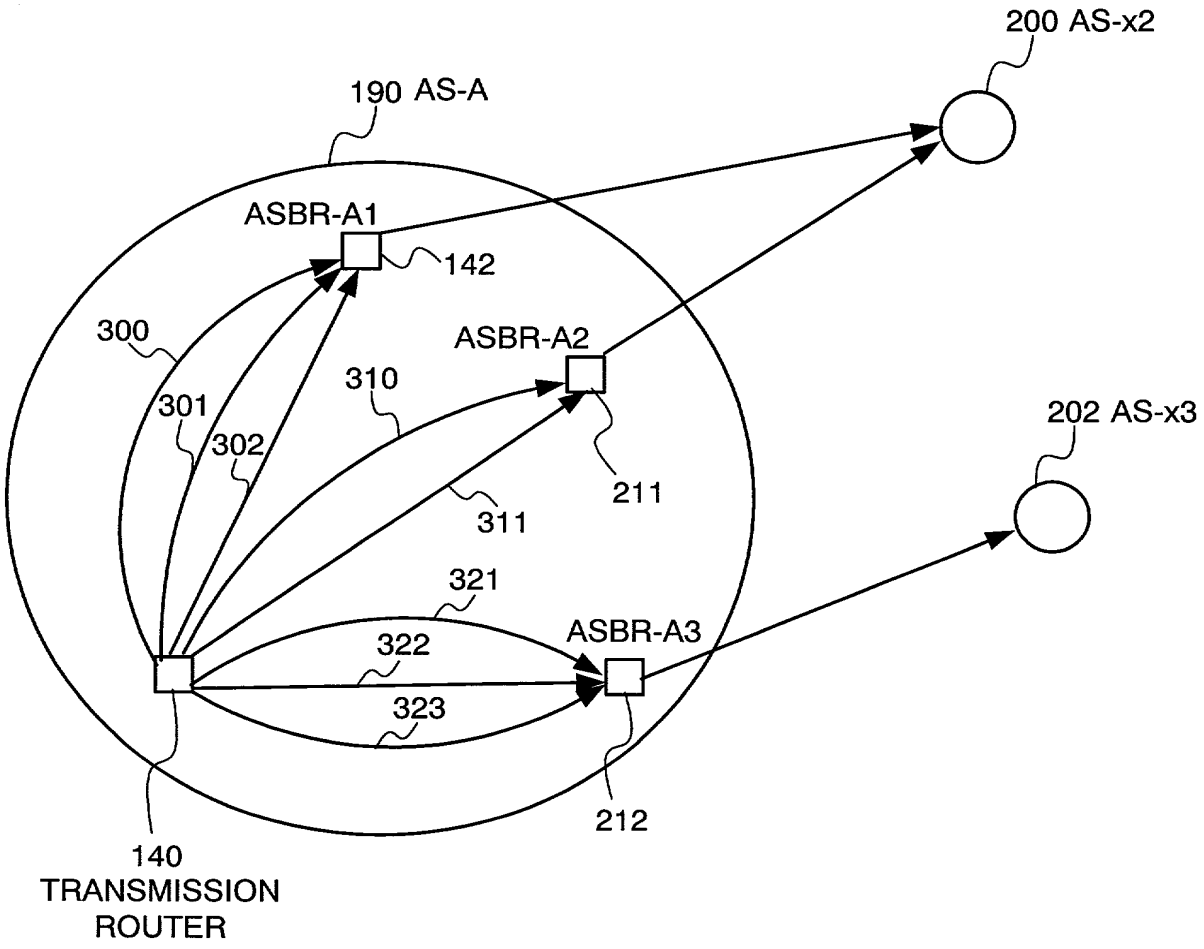

200 AS-x2
190 AS-A
ASBR-A1
142
300
ASBR-A2
310
301
302
211
202 AS-x3
311
321
ASBR-A3
322
323
212
140
TRANSMISSION
ROUTER

FIG. 5

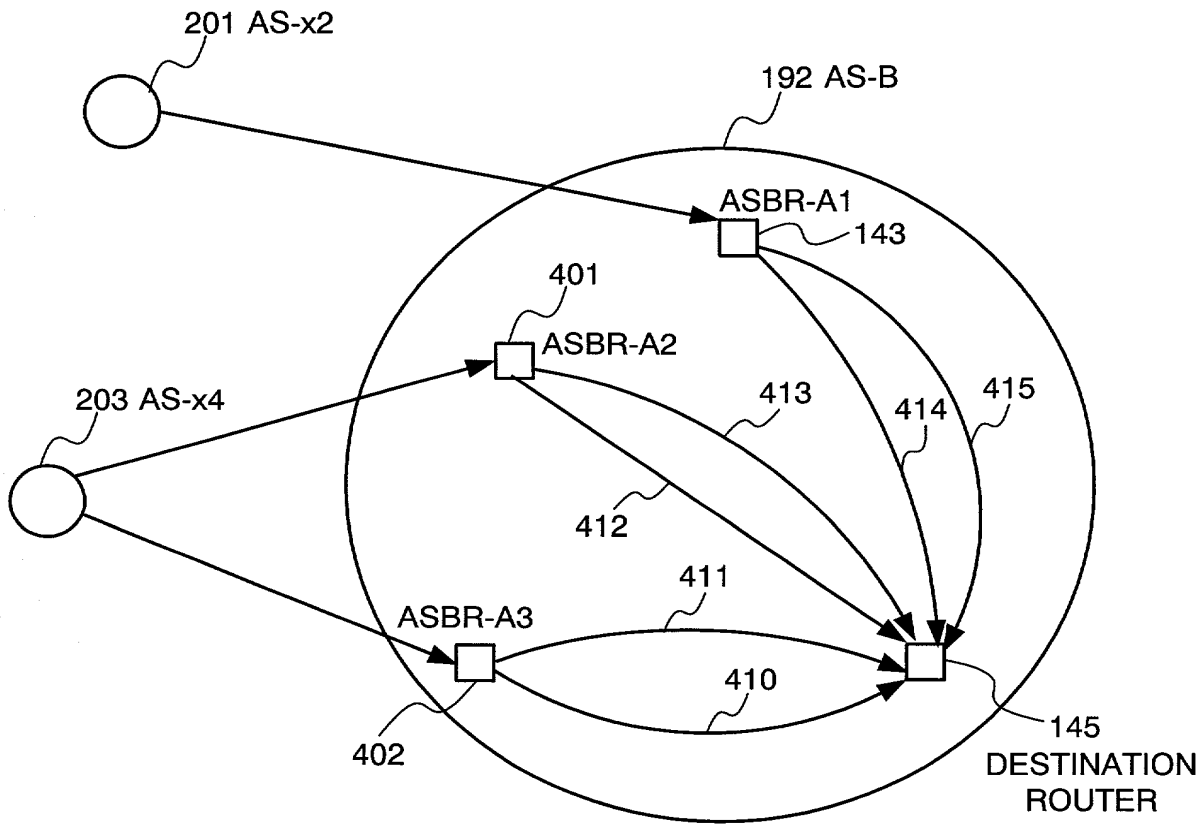

201 AS-x2
192 AS-B
ASBR-A1
143
401
ASBR-A2
203 AS-x4
413
414
415
412
411
ASBR-A3
410
145
DESTINATION
ROUTER
402

FIG. 6

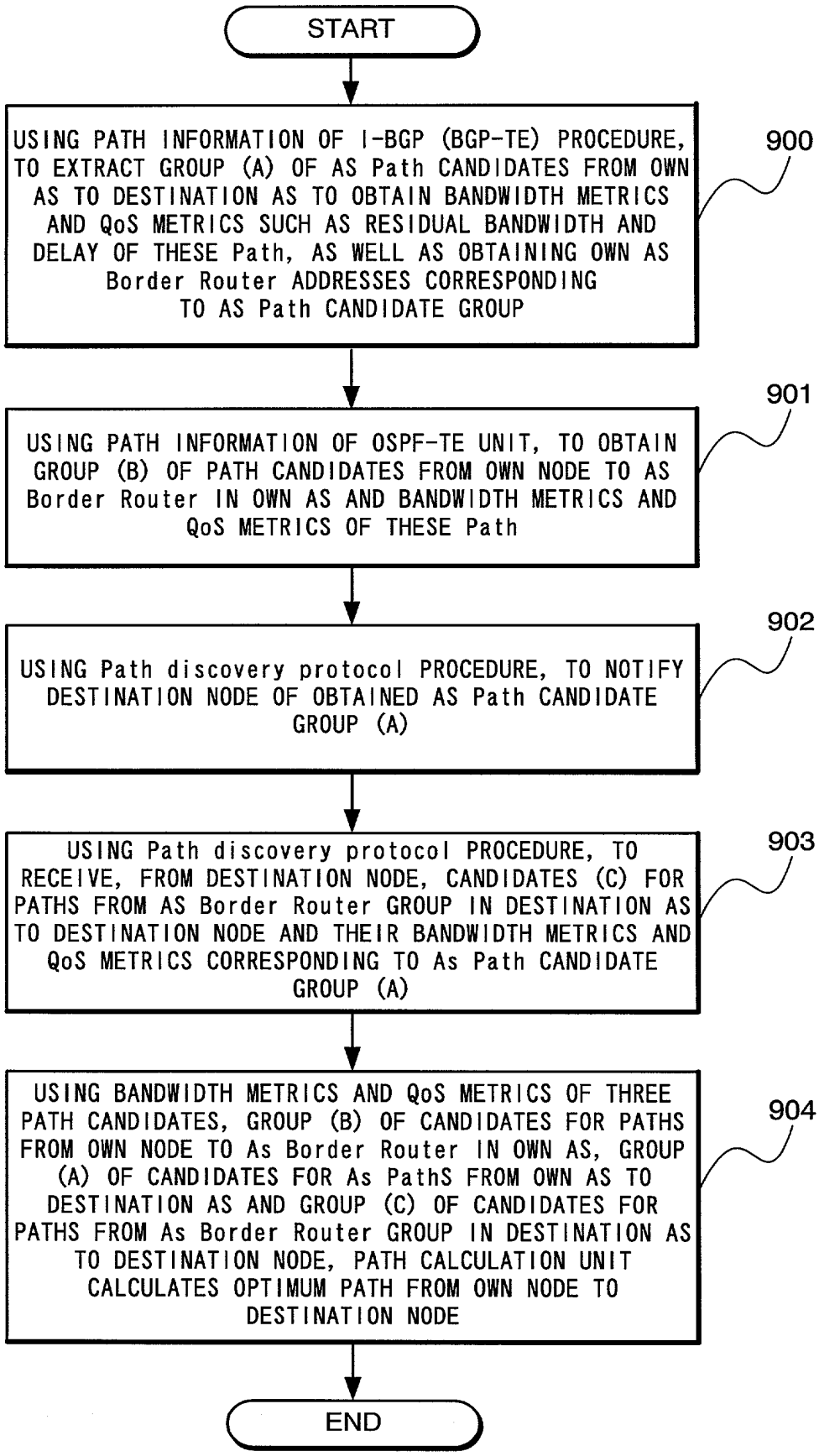
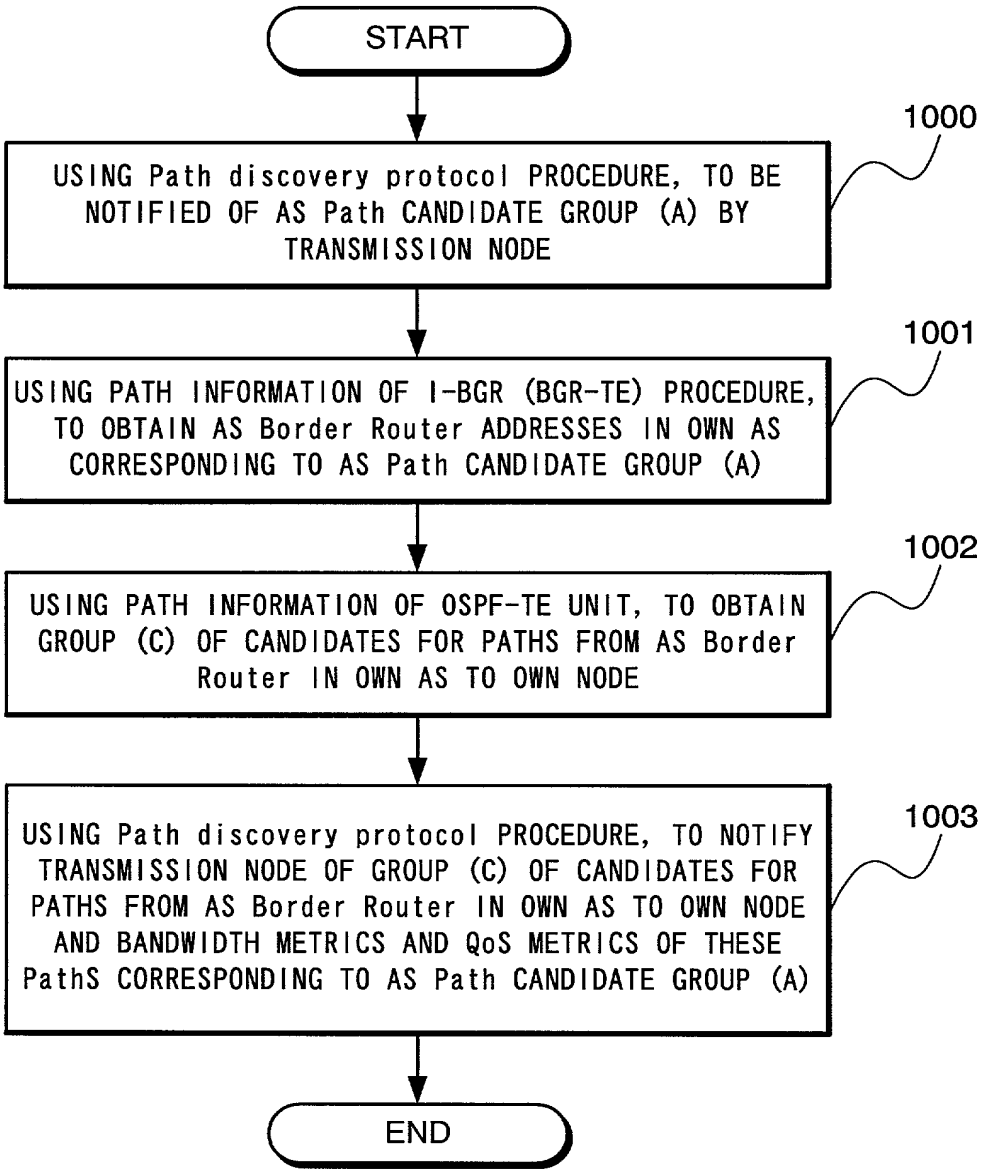

START
USING PATH INFORMATION OF I-BGP (BGP-TE) PROCEDURE, TO EXTRACT GROUP (A) OF AS Path CANDIDATES FROM OWN AS TO DESTINATION AS TO OBTAIN BANDWIDTH METRICS AND QoS METRICS SUCH AS RESIDUAL BANDWIDTH AND DELAY OF THESE Path, AS WELL AS OBTAINING OWN AS Border Router ADDRESSES CORRESPONDING TO AS Path CANDIDATE GROUP
900
USING PATH INFORMATION OF OSPF-TE UNIT, TO OBTAIN GROUP (B) OF PATH CANDIDATES FROM OWN NODE TO AS Border Router IN OWN AS AND BANDWIDTH METRICS AND QoS METRICS OF THESE Path
901
USING Path discovery protocol PROCEDURE, TO NOTIFY DESTINATION NODE OF OBTAINED AS Path CANDIDATE GROUP (A)
902
USING Path discovery protocol PROCEDURE, TO RECEIVE, FROM DESTINATION NODE, CANDIDATES (C) FOR PATHS FROM AS Border Router GROUP IN DESTINATION AS TO DESTINATION NODE AND THEIR BANDWIDTH METRICS AND QoS METRICS CORRESPONDING TO As Path CANDIDATE GROUP (A)
903
USING BANDWIDTH METRICS AND QoS METRICS OF THREE PATH CANDIDATES, GROUP (B) OF CANDIDATES FOR PATHS FROM OWN NODE TO As Border Router IN OWN AS, GROUP (A) OF CANDIDATES FOR As PathS FROM OWN AS TO DESTINATION AS AND GROUP (C) OF CANDIDATES FOR PATHS FROM As Border Router GROUP IN DESTINATION AS TO DESTINATION NODE, PATH CALCULATION UNIT CALCULATES OPTIMUM PATH FROM OWN NODE TO DESTINATION NODE
904
END

FIG. 7


START
1000
USING Path discovery protocol PROCEDURE, TO BE NOTIFIED OF AS Path CANDIDATE GROUP (A) BY TRANSMISSION NODE
1001
USING PATH INFORMATION OF I-BGR (BGR-TE) PROCEDURE, TO OBTAIN AS Border Router ADDRESSES IN OWN AS CORRESPONDING TO AS Path CANDIDATE GROUP (A)
1002
USING PATH INFORMATION OF OSPF-TE UNIT, TO OBTAIN GROUP (C) OF CANDIDATES FOR PATHS FROM AS Border Router IN OWN AS TO OWN NODE
1003
USING Path discovery protocol PROCEDURE, TO NOTIFY TRANSMISSION NODE OF GROUP (C) OF CANDIDATES FOR PATHS FROM AS Border Router IN OWN AS TO OWN NODE AND BANDWIDTH METRICS AND QoS METRICS OF THESE PathS CORRESPONDING TO AS Path CANDIDATE GROUP (A)
END

Patent application

FIG. 8

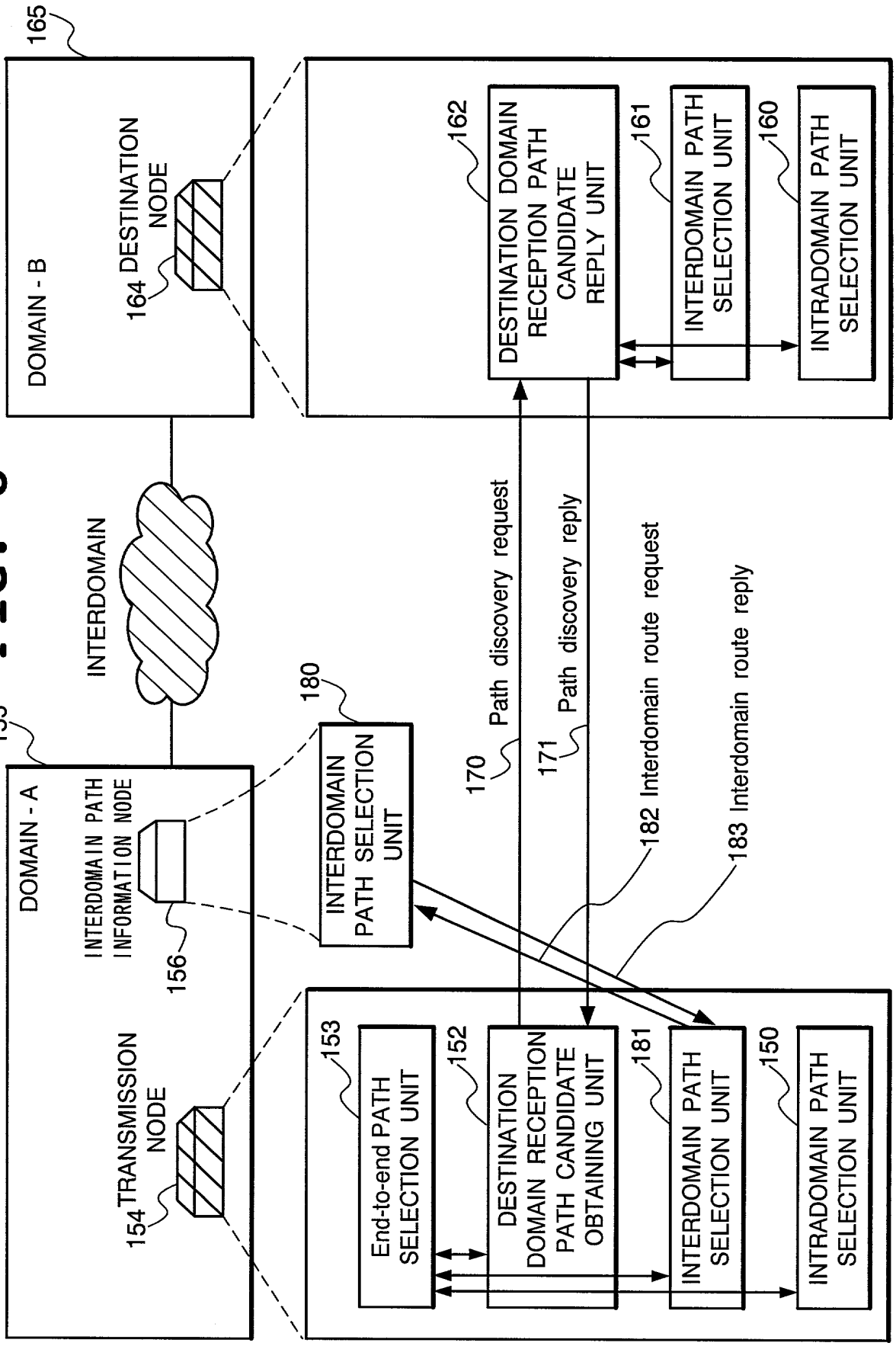


FIG. 9

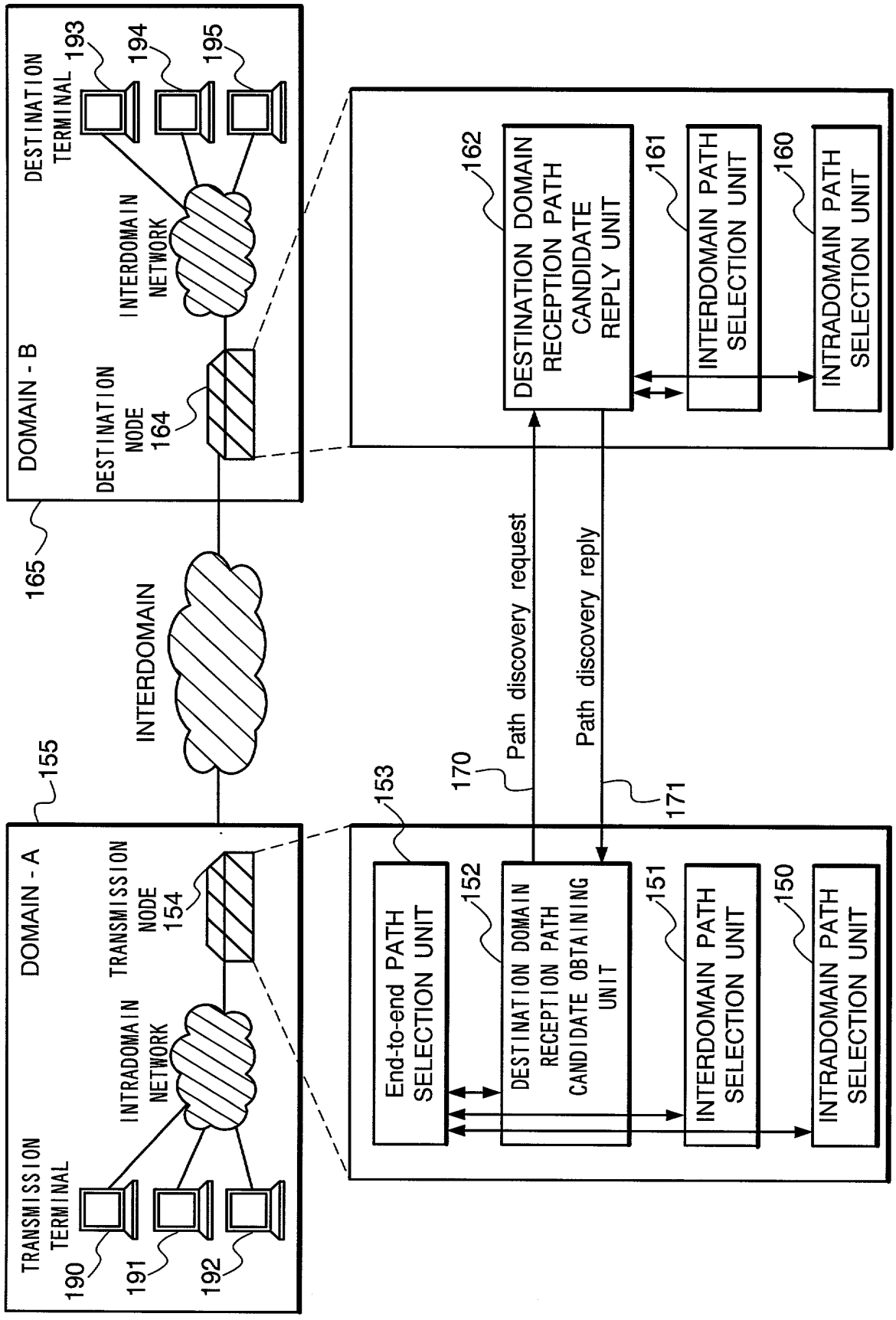

DOMAIN - A
155
TRANSMISSION TERMINAL
190
191
192
INTRADOMAIN NETWORK
TRANSMISSION NODE
154
INTERDOMAIN
165
DOMAIN - B
DESTINATION TERMINAL
193
194
195
INTERDOMAIN NETWORK
DESTINATION NODE
164
153
End-to-end PATH SELECTION UNIT
152
DESTINATION DOMAIN RECEPTION PATH CANDIDATE OBTAINING UNIT
151
INTERDOMAIN PATH SELECTION UNIT
150
INTRADOMAIN PATH SELECTION UNIT
170
Path discovery request
171
Path discovery reply
162
DESTINATION DOMAIN RECEPTION PATH CANDIDATE REPLY UNIT
161
INTERDOMAIN PATH SELECTION UNIT
160
INTRADOMAIN PATH SELECTION UNIT

FIG.10

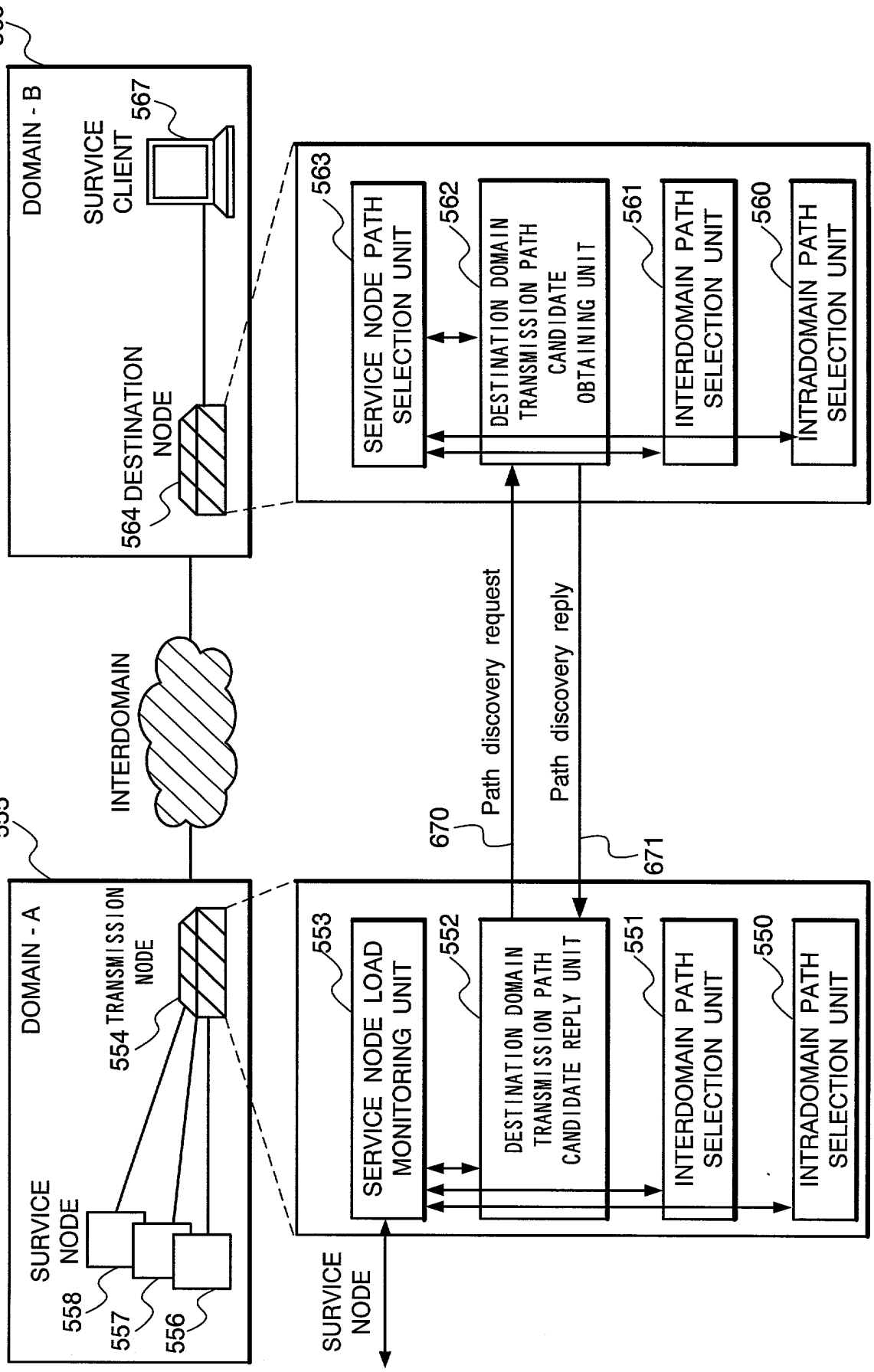

565
DOMAIN - B
SURVICE CLIENT
567
564 DESTINATION NODE
563
SERVICE NODE PATH SELECTION UNIT
562
DESTINATION DOMAIN TRANSMISSION PATH CANDIDATE OBTAINING UNIT
561
INTERDOMAIN PATH SELECTION UNIT
560
INTRADOMAIN PATH SELECTION UNIT
INTERDOMAIN
555
DOMAIN - A
554 TRANSMISSION NODE
SURVICE NODE
558
557
556
553
SERVICE NODE LOAD MONITORING UNIT
552
DESTINATION DOMAIN TRANSMISSION PATH CANDIDATE REPLY UNIT
551
INTERDOMAIN PATH SELECTION UNIT
550
INTRADOMAIN PATH SELECTION UNIT
670
Path discovery request
671
Path discovery reply
SURVICE NODE

FIG.11

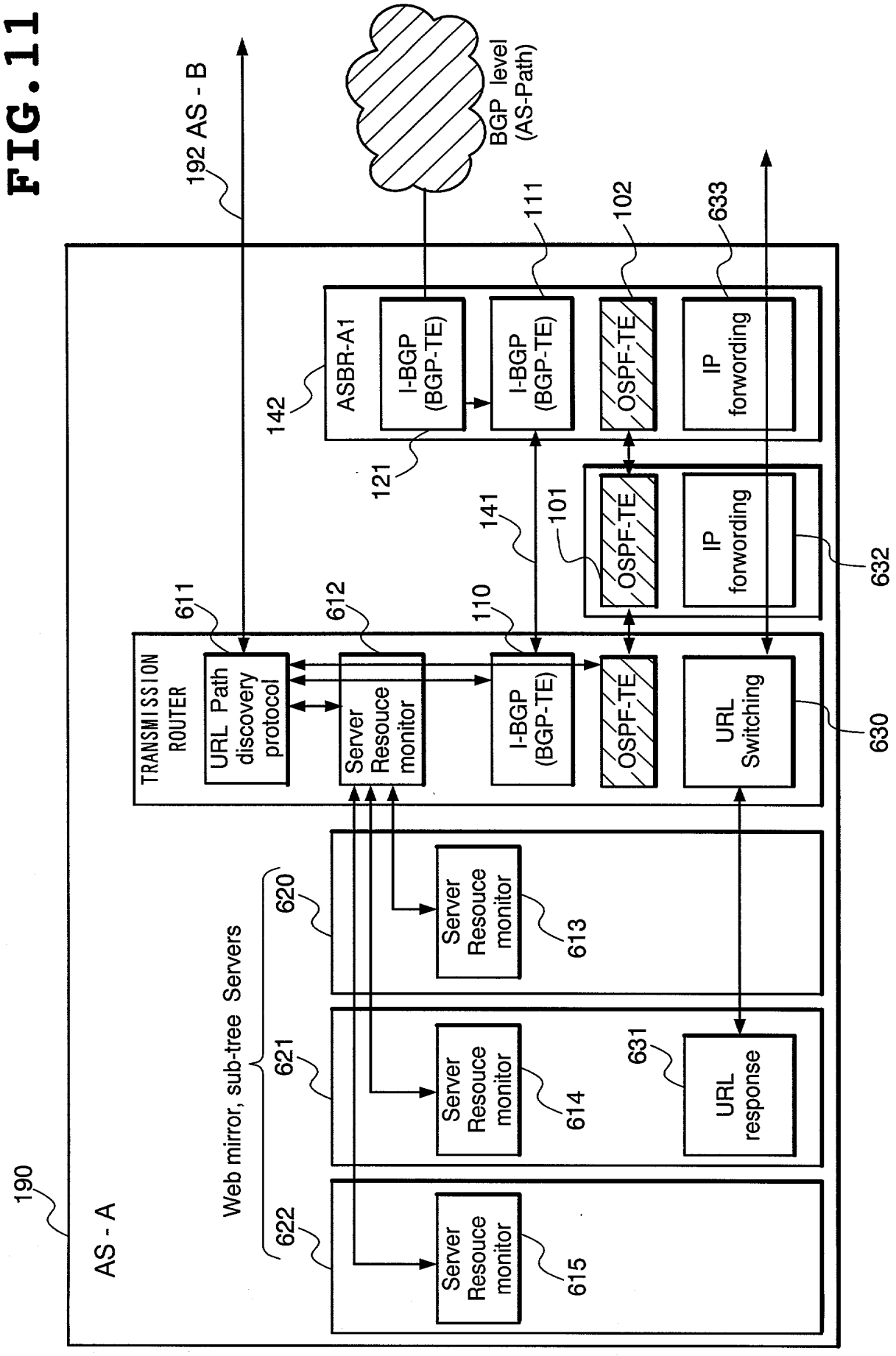

190
AS - A
192 AS - B
BGP level (AS-Path)
142
ASBR-A1
I-BGP (BGP-TE)
I-BGP (BGP-TE)
OSPF-TE
IP forwording
111
102
633
121
141
101
OSPF-TE
IP forwording
632
611
612
110
TRANSMISSION ROUTER
URL Path discovery protocol
Server Resouce monitor
I-BGP (BGP-TE)
OSPF-TE
URL Switching
630
Web mirror, sub-tree Servers
620
Server Resouce monitor
613
621
Server Resouce monitor
614
631
URL response
622
Server Resouce monitor
615

FIG. 12

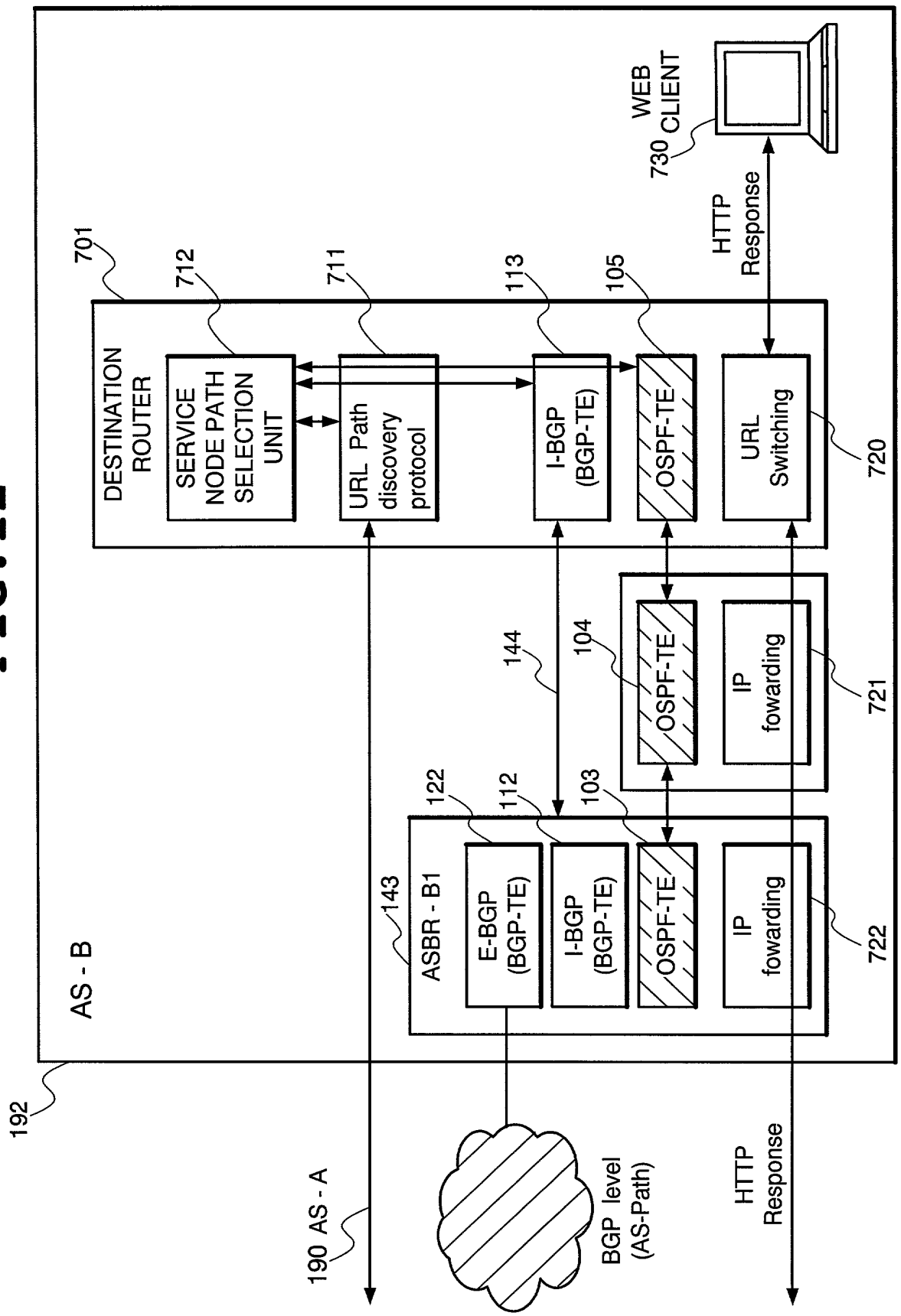

192
AS - B
190 AS - A
701
DESTINATION ROUTER
712
SERVICE NODE PATH SELECTION UNIT
711
URL Path discovery protocol
113
I-BGP (BGP-TE)
105
OSPF-TE
URL Switching
720
WEB CLIENT
730
HTTP Response
144
104
OSPF-TE
IP fowarding
721
122
112
103
143
ASBR - B1
E-BGP (BGP-TE)
I-BGP (BGP-TE)
OSPF-TE
IP fowarding
722
BGP level (AS-Path)
HTTP Response

FIG.13

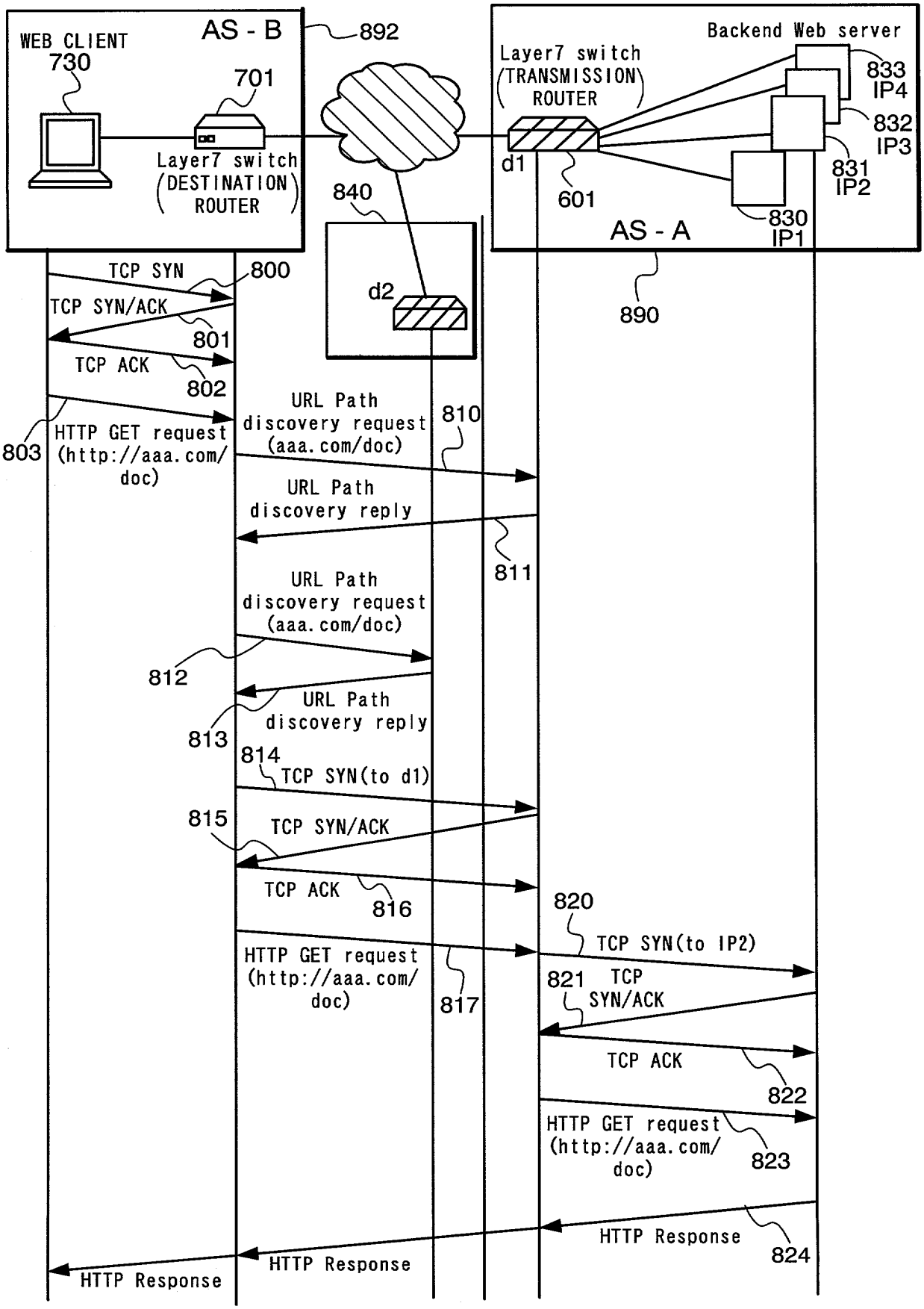

WEB CLIENT
730
AS - B
892
701
Layer7 switch
(DESTINATION
ROUTER
840
d2
Layer7 switch
(TRANSMISSION
ROUTER
d1
601
Backend Web server
833
IP4
832
IP3
831
IP2
830
IP1
AS - A
890
TCP SYN
800
TCP SYN/ACK
801
TCP ACK
802
803
HTTP GET request
(http://aaa.com/
doc)
URL Path
discovery request
(aaa.com/doc)
810
URL Path
discovery reply
811
URL Path
discovery request
(aaa.com/doc)
812
URL Path
discovery reply
813
814
TCP SYN(to d1)
815
TCP SYN/ACK
TCP ACK
816
820
TCP SYN(to IP2)
HTTP GET request
(http://aaa.com/
doc)
817
821
TCP
SYN/ACK
TCP ACK
822
HTTP GET request
(http://aaa.com/
doc)
823
HTTP Response
824
HTTP Response
HTTP Response

FIG.14

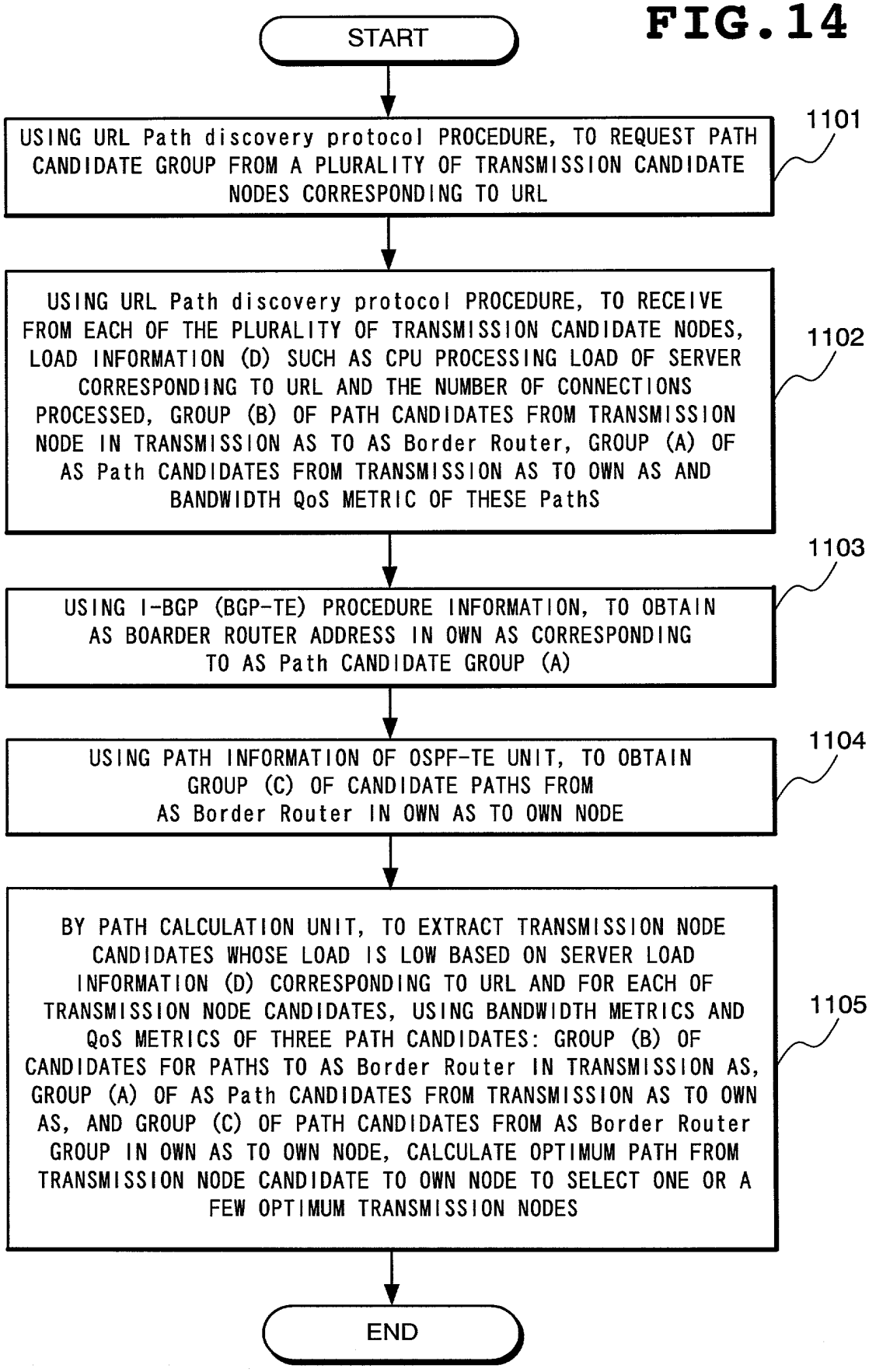

START
USING URL Path discovery protocol PROCEDURE, TO REQUEST PATH CANDIDATE GROUP FROM A PLURALITY OF TRANSMISSION CANDIDATE NODES CORRESPONDING TO URL
1101
USING URL Path discovery protocol PROCEDURE, TO RECEIVE FROM EACH OF THE PLURALITY OF TRANSMISSION CANDIDATE NODES, LOAD INFORMATION (D) SUCH AS CPU PROCESSING LOAD OF SERVER CORRESPONDING TO URL AND THE NUMBER OF CONNECTIONS PROCESSED, GROUP (B) OF PATH CANDIDATES FROM TRANSMISSION NODE IN TRANSMISSION AS TO AS Border Router, GROUP (A) OF AS Path CANDIDATES FROM TRANSMISSION AS TO OWN AS AND BANDWIDTH QoS METRIC OF THESE PathS
1102
USING I-BGP (BGP-TE) PROCEDURE INFORMATION, TO OBTAIN AS BOARDER ROUTER ADDRESS IN OWN AS CORRESPONDING TO AS Path CANDIDATE GROUP (A)
1103
USING PATH INFORMATION OF OSPF-TE UNIT, TO OBTAIN GROUP (C) OF CANDIDATE PATHS FROM AS Border Router IN OWN AS TO OWN NODE
1104
BY PATH CALCULATION UNIT, TO EXTRACT TRANSMISSION NODE CANDIDATES WHOSE LOAD IS LOW BASED ON SERVER LOAD INFORMATION (D) CORRESPONDING TO URL AND FOR EACH OF TRANSMISSION NODE CANDIDATES, USING BANDWIDTH METRICS AND QoS METRICS OF THREE PATH CANDIDATES: GROUP (B) OF CANDIDATES FOR PATHS TO AS Border Router IN TRANSMISSION AS, GROUP (A) OF AS Path CANDIDATES FROM TRANSMISSION AS TO OWN AS, AND GROUP (C) OF PATH CANDIDATES FROM AS Border Router GROUP IN OWN AS TO OWN NODE, CALCULATE OPTIMUM PATH FROM TRANSMISSION NODE CANDIDATE TO OWN NODE TO SELECT ONE OR A FEW OPTIMUM TRANSMISSION NODES
1105
END

FIG.15

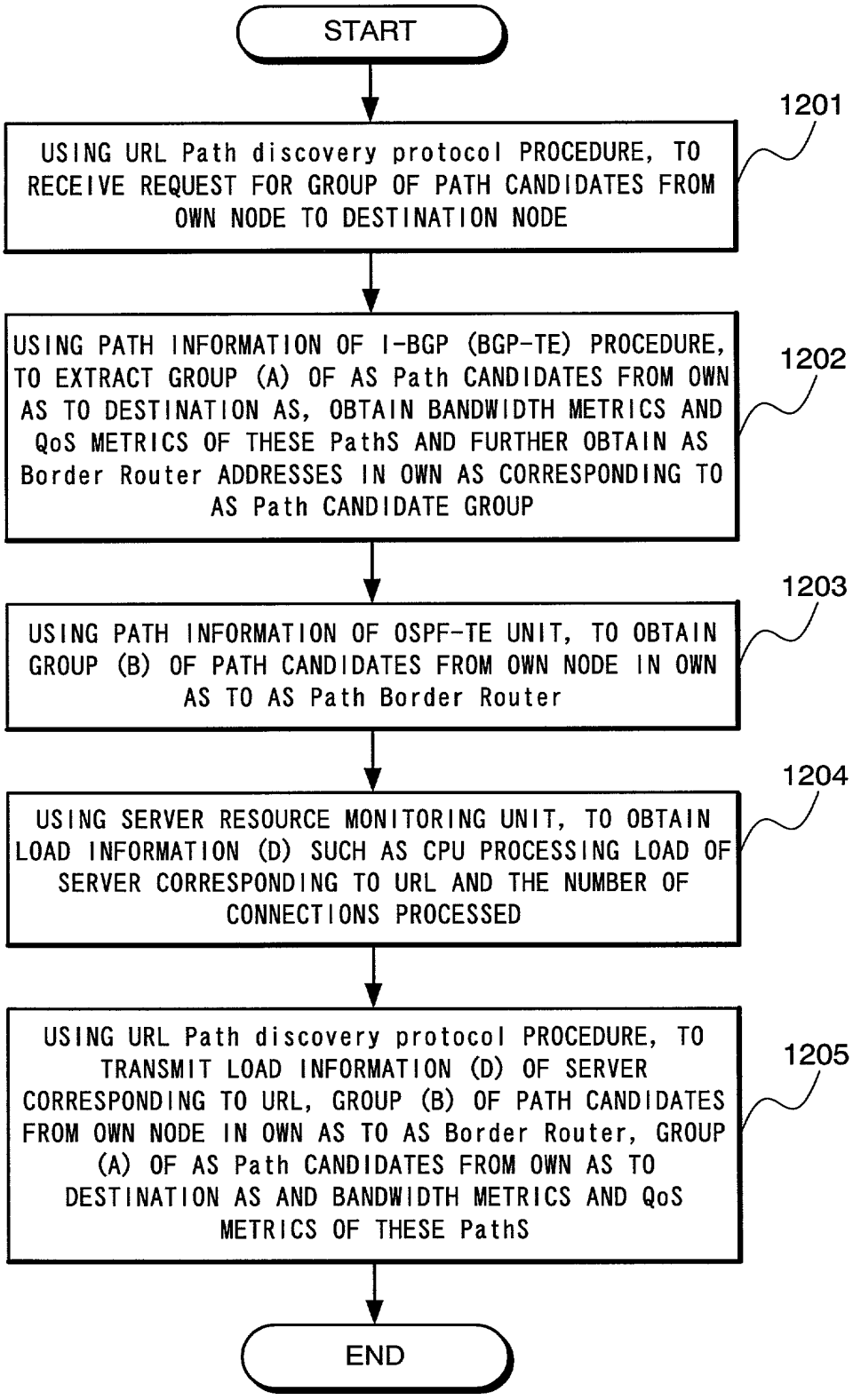
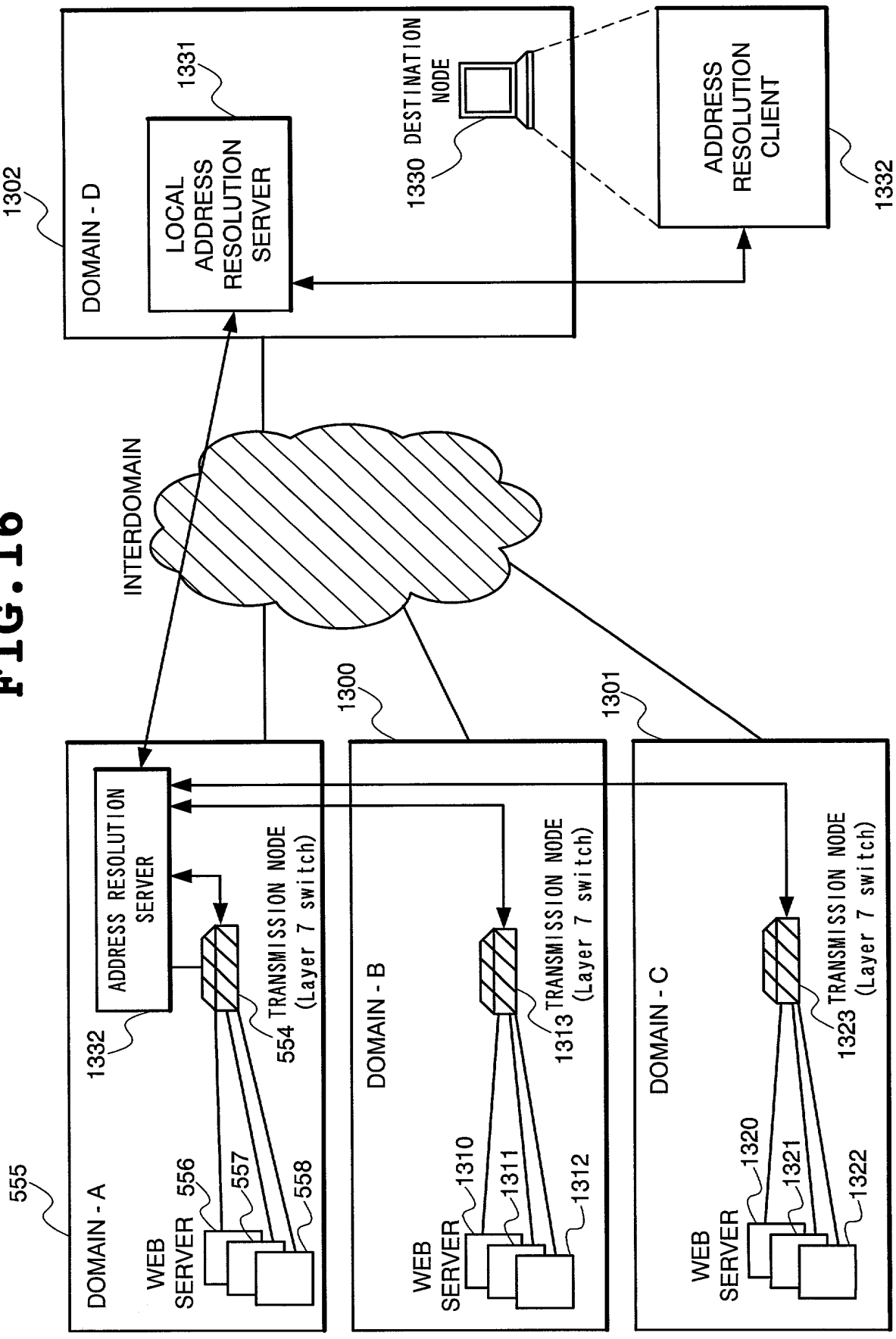

START
1201
USING URL Path discovery protocol PROCEDURE, TO RECEIVE REQUEST FOR GROUP OF PATH CANDIDATES FROM OWN NODE TO DESTINATION NODE
1202
USING PATH INFORMATION OF I-BGP (BGP-TE) PROCEDURE, TO EXTRACT GROUP (A) OF AS Path CANDIDATES FROM OWN AS TO DESTINATION AS, OBTAIN BANDWIDTH METRICS AND QoS METRICS OF THESE PathS AND FURTHER OBTAIN AS Border Router ADDRESSES IN OWN AS CORRESPONDING TO AS Path CANDIDATE GROUP
1203
USING PATH INFORMATION OF OSPF-TE UNIT, TO OBTAIN GROUP (B) OF PATH CANDIDATES FROM OWN NODE IN OWN AS TO AS Path Border Router
1204
USING SERVER RESOURCE MONITORING UNIT, TO OBTAIN LOAD INFORMATION (D) SUCH AS CPU PROCESSING LOAD OF SERVER CORRESPONDING TO URL AND THE NUMBER OF CONNECTIONS PROCESSED
1205
USING URL Path discovery protocol PROCEDURE, TO TRANSMIT LOAD INFORMATION (D) OF SERVER CORRESPONDING TO URL, GROUP (B) OF PATH CANDIDATES FROM OWN NODE IN OWN AS TO AS Border Router, GROUP (A) OF AS Path CANDIDATES FROM OWN AS TO DESTINATION AS AND BANDWIDTH METRICS AND QoS METRICS OF THESE PathS
END

FIG.16


1302
DOMAIN - D
LOCAL ADDRESS RESOLUTION SERVER
1331
1330 DESTINATION NODE
ADDRESS RESOLUTION CLIENT
1332
INTERDOMAIN
1300
1301
555
DOMAIN - A
ADDRESS RESOLUTION SERVER
1332
554 TRANSMISSION NODE (Layer 7 switch)
WEB SERVER 556
557
558
DOMAIN - B
1313 TRANSMISSION NODE (Layer 7 switch)
WEB SERVER 1310
1311
1312
DOMAIN - C
1323 TRANSMISSION NODE (Layer 7 switch)
WEB SERVER 1320
1321
1322